What is claimed is:

1. A plasma processing apparatus comprising:

a processing container in form of a cylinder with a bottom;

a supporting unit disposed in the processing container to support an object to be processed;

a dielectric window arranged in an opening of the processing container to close up the processing container in an air-tight manner, the dielectric window being made of dielectric allowing a high-frequency wave to permeate the dielectric window into an interior of the processing container;

an annular waveguide shaped in form of a ring to introduce the high-frequency wave into the processing container through the dielectric window and also fitted to the dielectric window so that a plane containing an annular waveguide path of the annular waveguide extends along the dielectric window; and

a traveling-wave generator arranged at the annular waveguide to produce a traveling wave in form of an endless ring in the annular waveguide.

2. A plasma processing apparatus as claimed in Claim 1, wherein the traveling-wave generator includes:

a high-frequency wave generator for supplying the high-frequency wave;

a propagation waveguide connected to the high-frequency wave generator to propagate the high-frequency wave generated in the high-frequency wave generator; and

a directional coupler arranged between the propagation waveguide and the annular waveguide to connect the propagation waveguide with the annular waveguide thereby to supply the annular waveguide with the high-frequency wave which has been propagated in the propagation waveguide, as the traveling wave.

3. A plasma processing apparatus as claimed in Claim 2, wherein the annular waveguide has its circumferential length a natural number of times as long as a wave length in the annular waveguide.

4. A plasma processing apparatus as claimed in Claim 1, wherein the traveling-wave generator has a multiphase high-frequency wave supplier for supplying several positions apart from each other in the circumferential direction of the annular waveguide with high-frequency waves whose phases are shifted from each other in the circumferential direction, whereby the supply of the high-frequency waves whose phases are shifted from each other in the circumferential direction of the annular waveguide allows the traveling wave to be generated in the annular waveguide.

5. A plasma processing apparatus as claimed in Claim 4, wherein the multiphase high-frequency wave supplier comprises:

a high-frequency wave generator for generating a high-frequency wave in TE11 mode;

a cylindrical waveguide having its one end connected to the high-frequency wave generator;

a circularly-polarized wave converter arranged in the middle of the cylindrical waveguide to rotate the high-frequency wave in TE11 mode being propagated in the cylindrical waveguide about an axis of the cylindrical waveguide; and

a plurality of branch waveguides having respective one ends connected to an outer face of another end of the cylindrical waveguide at respective positions apart from each other in the circumferential direction of the cylindrical waveguide and also having the other ends connected to the annular waveguide at respective positions apart from each other in the circumferential direction of the annular waveguide.

6. A plasma processing apparatus as claimed in Claim 4, wherein the multiphase high-frequency wave supplier comprises:

a high-frequency wave generator for generating a high-frequency wave in TE11 mode in the waveguide;

a plurality of branch waveguides having respective one ends connected to the waveguide and the other ends connected to the annular waveguide at respective positions apart from each other in the circumferential direction of the annular waveguide; and

phase shifters arranged in the branch waveguides

respectively to control respective phases of plural high-frequency waves divided by the branch waveguides so that a traveling wave is generated in the annular waveguide when the high-frequency waves are supplied into the annular waveguide.

7. A plasma processing apparatus as claimed in Claim 5, wherein circumferential length of the annular waveguide is natural number of times as long as a wave length in the annular waveguide.

8. A plasma processing apparatus as claimed in Claim 5, wherein the waveguide to supply the annular waveguide with the high-frequency wave is shaped to be rectangular.

9. A plasma processing apparatus as claimed in Claim 5, wherein the waveguide to supply the annular waveguide with the high-frequency wave is a coaxial waveguide.

10. A plasma processing apparatus as claimed in Claim 1, further comprising a gas supply tube for supplying the processing container with gas, wherein the gas supply tube has its opening connected to a part of the dielectric window surrounded by the annular waveguide.

11. A plasma processing apparatus as claimed in Claim 1, wherein the dielectric window is provided, at its part surrounded by the annular waveguide, with an opposing electrode arranged in opposition to the supporting unit.

12. A plasma processing apparatus as claimed in Claim 1, wherein the dielectric window is provided, at its part surrounded by the annular waveguide, with a leading end of a gas supply tube for supplying the processing container with gas, the leading end having an opening formed to supply the gas into the processing container and also becoming an opposing electrode arranged in opposition to the supporting unit.

13. A plasma processing apparatus as claimed in Claim 11, wherein

the opposing electrode is grounded for earth.

14. A plasma processing apparatus as claimed in Claim 11, wherein the opposing electrode is connected to a high-frequency power source.

15. A plasma processing apparatus as claimed in Claim 1, wherein the annular waveguide is in form of a circular loop.

16. A plasma processing apparatus as claimed in Claim 1, wherein the annular waveguide is in form of a rectangular loop.

17. A plasma processing apparatus as claimed in Claim 1, wherein the high-frequency wave supplied to the annular waveguide has a frequency from 200 MHz to 35 GHz.